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SCROLL COMPRESSOR
[Sukuroru asshukuki]

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[Claims] /2*

[Claim 1] A scroll compressor comprising an orbiting scroll provided with flat, spiral-shaped orbiting laps on both sides, a stationary scroll to which are provided stationary laps disposed to both sides of the orbiting scroll and combined in an eccentric state so as to face the orbiting laps, and a drive shaft provided so as to pass through the orbiting scroll and the stationary scroll and causing the orbiting scroll to move in an eccentric circle inside the stationary scroll, compressing gas by causing the orbiting scroll to move in an eccentric circle while stopping rotation of the orbiting scroll with respect to the stationary scroll, wherein a groove is formed on an outer circumferential face of a flat plate of the orbiting scroll, and contained in the groove is an Oldham coupling which tolerates eccentric circular motion while stopping rotation of the orbiting scroll by engaging the orbiting scroll.

[Claim 2] The scroll compressor according to Claim 1, wherein a balance weight countering the eccentric circular motion of the orbiting scroll is attached to an outer side of one of the stationary scrolls along the drive shaft, and a balance weight countering the moment acting on the drive shaft is attached to an outer side of the other stationary scroll.

[Claim 3] The scroll compressor according to Claim 1 or 2, wherein an end portion of an outer curve line of an orbiting lap of

* Claim and paragraph numbers correspond to those in the foreign text.

the orbiting scroll is formed so as to approximate or match an outer circumferential edge of a flat plate of the orbiting scroll.

[Claim 4] The scroll compressor according any one of Claims 1 to 3, wherein the Oldham coupling is split and linked at a central portion of a key portion.

[Claim 5] The scroll compressor according to any one of Claims 1 to 4, wherein the stationary scroll is supported so as to be able to advance and retreat in an axial direction of the drive shaft.

[Detailed Description of the Invention]

[0001]

[Industrial Field of the Invention] The present invention relates to a scroll compressor used in cooling air conditioners, air compressors, and other apparatuses, and relates in particular to a scroll compressor wherein an orbiting scroll comprises orbiting laps on both sides of a flat plate, and a drive shaft for causing the orbiting scroll to move in an eccentric circle is provided so as to pass through the orbiting scroll and a stationary scroll.

[0002]

[Prior Art]

[Patent Document 1] JP H5-187372 A

As is described in, for example, JP H5-187372 A, for this type of scroll compressor, a constitution has been disclosed comprising one orbiting scroll in which single involute laps are formed on both faces of a flat plate (mirror plate) in an axial direction, a pair of

stationary scrolls in which one involute lap coupling with the laps of the orbiting scroll are formed, a main axis passing through the orbiting scroll and the stationary scrolls for causing the orbiting scroll to orbit, and further three driven crank shafts and shaft bearings for restricting rotation provided around the space in which the laps are formed, positioned 120° apart in a circumferential direction. Further, a constitution is disclosed in which a groove is provided to a lap end face opposing a mirror face of a paired scroll, a self-lubricating sealing member (tip seal) is introduced into the groove, and the lap end face and the scroll paired thereto are slid via this tip seal.

[0003]

[Problem(s) to be Solved by the Invention] This kind of conventional scroll compressor requires that a spiral-shaped lap start being coiled from the outer side thereof, since the main shaft passes through the center of the scroll. Since the volume of the minimum shut-in chamber formed by the laps having an involute or other curve grows the closer the shut-in chamber is to the outer circumference, the number of coils of the lap must be increased in order to ensure a predetermined built-in compression ratio (a ratio of compression chamber volume when initiating compression to compression chamber volume when initiating ejection), thus causing the outer shape of the scroll (diameter) to grow. Further, since the rotation preventing mechanism for preventing rotation of the orbiting

scroll is formed on the outer circumferential edge portion protruding further out than the end of the coil of the lap mirror plate, the problem arises of the outer shape of the compressor growing even more. Accordingly, with such a conventional scroll compressor, it is impossible to constitute a scroll compressor for, for example, cooling air conditioning, having a required scroll compressor rated drive power of five-horsepower and a compact aspect in which the outer shape (diameter) of the compressor is 160 mm or less.

[0004] Since the mirror plate on the orbiting scroll side is formed relatively thickly, there are the problems of the weight of the orbiting compressor growing overall, the shaft bearing load from the centrifugal force attendant to the eccentric rotation growing, and vibration increasing. Further, since the lap end face and the scroll paired to it slide via a tip seal, there is the problem of significant adverse effects on efficiency and reliability of the scroll compressor depending on the anti-wear properties of the tip seal.

[0005] An object of the present invention is to provide a scroll compressor which is compact and has good performance and reliability.

[0006] Specifically, an object of the present invention is in realizing an aspect optimized for high-speed orbiting and in which the outer size of an orbiting scroll is small, making it possible to realize maintaining output control over a wide range with quiet operation.

[0007] Further, an object of the present invention is in enabling maintenance of stable operation by appropriately maintaining the gap formed at the tip of the lap and preventing a large force from acting on the orbiting scroll by abnormal increases in liquid compression or compression chamber pressure.

[0008]

[Means for Solving the Problem(s)] A first aspect of the present invention is a scroll compressor comprising an orbiting scroll provided with flat, spiral-shaped orbiting laps on both sides, a stationary scroll to which are provided stationary laps disposed to both sides of the orbiting scroll and combined in an eccentric state so as to face the orbiting laps, and a drive shaft provided so as to pass through the orbiting scroll and the stationary scroll and causing the orbiting scroll to move in an eccentric circle inside the stationary scroll, compressing gas by causing the orbiting scroll to move in an eccentric circle while stopping rotation of the orbiting scroll with respect to the stationary scroll, wherein a groove is formed on an outer circumferential face of a flat plate of the orbiting scroll, and contained in the groove is an Oldham coupling which tolerates eccentric circular motion while stopping rotation of the orbiting scroll by engaging the orbiting scroll.

[0009] Specifically, the end portion of the outer curve of the orbiting lap of the orbiting scroll is formed so as to approximate or match the outer circumferential edge of the flat plate of the

orbiting scroll, and the Oldham coupling is split and linked at the center of the key portion.

[0010] Further, a communicating path is provided communicating between an action chamber for pressurizing the stationary scroll in the direction of the orbiting scroll and a compression chamber formed by the action chamber and the laps of the orbiting scroll and the stationary scroll in the frame advanceably and retreatably supporting the stationary scroll and the stationary scroll.

[0011] The orbiting scroll is split in two in the axial direction of the drive shaft at a position on the flat plate, and the split faces are opposed and linked.

[0012] Further, an elastic body is interposed between the split faces of the orbiting scroll thus split and stretchably linked in the axial direction, a groove is formed in an outer circumferential portion of the split faces, and an Oldham coupling allowing eccentric circular motion while stopping rotation of the orbiting scroll is disposed inside the groove engaged with the orbiting scroll.

[0013] Further, the outer dimension of the compressor is constituted to have a diameter of no more than 160 mm in the required rated drive power class of five horsepower.

[0014] The structure in which the end face portion of the outer curve of the end of the coil of the orbiting lap approximates or matches the outer edge of the flat plate (mirror plate) can reduce the outer shape of the mirror plate of the orbiting scroll. Further,

the outer shape of the compressor can be made smaller with a constitution in which the Oldham coupling is formed in a ring shape, a structure in which a division into two is made at the center of the key width, and the Oldham coupling is contained in the groove formed around the mirror plate of the orbiting scroll, and slid. Accordingly, with a scroll compressor for cooling air conditioning, for example, an outer shape of the compressor with a required compressor rated drive force of five horsepower has a diameter of 160 mm or less is possible.

[0015] Further, a constitution in which the stationary scroll and the orbiting scroll release relative to each other in the axial direction makes is possible to operate the compressor while maintaining an appropriate space between the lap tip of the orbiting scroll and the lap tip of the stationary scroll all the time, and if a phenomenon occurs such as an abnormal increase in liquid compression or compression chamber pressure, it is possible to escape the abnormal load to the sliding surface between the side face of the outer circumferential portion of the mirror plate of the orbiting scroll and the side of the outer circumferential portion of the mirror face of the stationary scroll, by releasing the stationary scroll from the orbiting scroll.

[0016]

[Embodiments of the Invention] A description of examples of the present invention is given below, with reference to the drawings.

[0017] FIG. 1 is a vertical cross-section lateral view showing a first example of the scroll compressor according to the present invention cut open and expanded at an angle of 90°, FIG. 2 is an oblique view of an Oldham coupling used in this example, FIG. 3 is a horizontal cross-section plane view of the orbiting scroll, and FIG. 4 and FIG. 5 are horizontal cross-section plane views of the stationary (fixed) scroll.

[0018] In FIG. 1, the scroll compressor is constituted by a cylindrical sealed container 1 sealed at both ends and with the center of its axis substantially vertical, a first frame 2 and a second frame 3 fixed to the top of the sealed container 1 with the centers of the axes thereof matching the center of the axis of the sealed container 1, a first stationary scroll 4 and a second stationary scroll 5 to the sides of which are formed spiral-shaped stationary laps, attached so as to be slidable in the axial direction to the first frame 2 and the second frame 3, respectively, so as to oppose one another, the stationary laps being faced down and up, respectively, and the centers of the axes thereof matching the first frame 2 and the second frame 3, a two-geared orbiting scroll 6 in which spiral-shaped orbiting laps are formed symmetrically to both sides of a flat plate, the laps being opposed so as to hold the first stationary scroll 4 and the second stationary scroll 5 like a sandwich, a stator 7a and a rotor 7b constituting an electric motor for driving the orbiting scroll disposed below the second frame 3

matching the center of the axis thereof with that of the first stationary scroll 4 and the secondary stationary scroll 5, a crank shaft 8 for rotating by being linked to the rotor 7b and causing the orbiting scroll 6 to move in an eccentric circle via an orbiting shaft bearing 6b, a suction tube 9 for supplying gas to be compressed to a space formed by the stationary lap of the first stationary scroll 4 and the orbiting lap of the orbiting scroll 6, an ejection tube 10 disposed passing through a wall face of the sealed container 1, and so on. The second frame 3 is fixed to the wall face of the sealed container 1, and the first frame 2 is fixed to the second frame 3 by a through bolt passing through the first stationary scroll 4 and the second stationary scroll 5 from the first frame 2.

[0019] The crank shaft 8, which is a drive shaft, is constituted by a rotor link portion 8d linked to the rotor 7b, a lower supporting shaft portion 8b extending up from the rotor link portion 8d and supported by a second frame shaft bearing 3a fixed to the center of the second frame 3, an eccentric shaft portion 8a extending up from the lower supporting shaft portion 8b and fitted to the orbiting shaft bearing 6b, an upper supporting shaft portion 8c extending up from the eccentric shaft portion 8a and supported by a first frame shaft bearing 2a fixed to the center of the first frame 2, and a lower end supporting shaft portion 8e extending down from the rotor link portion 8d and supported by an auxiliary shaft bearing 12 formed on an auxiliary frame 11 fixed to a side wall of the sealed container

1. On the crank shaft 8, a lower balance weight 13 is attached to the lower supporting shaft portion 8b and an upper balance weight 14 is attached to the upper supporting shaft portion 8c in order to prevent generation of vibration by canceling the centrifugal force of the orbiting scroll 6 and the moment created by the centrifugal force. Further, the second frame shaft bearing 3a has a stop-guard shaft bearing structure, and supports the weight of the crank shaft 8 and the rotor 7b.

[0020] The orbiting scroll 6 is restricted so as not to rotate (rotate around the eccentric shaft portion 8a) by an Oldham coupling 15, and moves (orbits) in an eccentric circle, driven by the rotation of the eccentric shaft portion 8a.

[0021] The Oldham coupling 15 is, as shown in FIG. 2, formed in an elliptical ring shape, linking two ring portions 15a and 15b, and comprises six key portions 15c, 15d, 15e, 15f, 15g, and 15h. The end faces in the key width direction of the key portions 15c and 15h and the key portions 15e and 15f formed abutting faces linking the two rink portions 15a and 15b. The key portions 15d and 15g of the Oldham coupling 15 engage key grooves 6c and 6d formed in the orbiting scroll 6 shown in FIG. 3 and allow the orbiting scroll 6 to slide relative to the key groove direction, and the key portions 15c and 15h and the key portions 15e and 15f engage key grooves 5b and 5c formed in the second stationary scroll 5 shown in FIG. 4, and slide relative to the key groove direction. The minor axis area of the ring

portions 15a and 15b of the Oldham coupling 15 are contained in the groove portion 6e such that the groove portion 6e formed in the center in the width direction of the outer face of the mirror plate of the orbiting scroll 6 slides relative to the key groove direction, and the major axis area is exposed outside the outer face and engages the key grooves 5b and 5c of the second stationary scroll 5 so as to slide in the key groove direction.

[0022] As regards the orbiting scroll 6, as shown in FIG. 3, the coil start portion (center) of the orbiting lap 6a formed on both sides of the mirror plate 6f is formed as an arc, and the end portion of the outer curve of the orbiting lap 6a approximates or matches the outer circumferential edge of the mirror plate 6f. This shape makes it possible to make smaller the outer shape of the mirror plate 6f of the orbiting scroll 6 with respect to the number of coils of the orbiting lap 6a. Ejection paths 6g (6i) and an ejection hole 6h are provided to the outer circumferential portion of the orbiting shaft bearing 6a. The ejection paths 6g (6i) are formed in both sides in the axial direction of the orbiting scroll 6 (top and bottom side faces in FIG. 1) and communicate with the ejection hole 6h.

[0023] As shown in FIG. 4, as regards the second stationary scroll 5, the coil start portion (inner end) of the stationary lap 5a and the coil end portion (outer end) are both formed as arcs, and a fitting hole 5d is provided to the vicinity of the inside of the coil start portion of the stationary lap 5a. On the other hand, a suction

path 5e is provided to the vicinity of the inside of the coil start portion of the stationary lap 5a.

[0024] As shown in FIG. 5, as regards the first stationary scroll 4, a suction hole 4b communicating with the suction tube 9 disposed passing through the wall face of the sealed container 1 is open near the coil end portion (outer end) of the stationary lap 4a. On the other hand, an ejection hole 4c is provided near the coil start portion (inner end) of the stationary lap 4a so as to open into the ejection path 6g formed in both ends (top end in FIG. 1) in the axial direction of the orbiting scroll 6. The ejection hole 4c communicates with an ejection space 1a in the top of the sealed container 1 by an ejection path 2c formed in the first frame 2.

[0025] The segment enclosed by the orbiting lap 6a of the orbiting scroll 6, the stationary lap 4a of the first stationary scroll 4, and the stationary lap 5a of the second stationary scroll 5 forms compression chambers 16 and 17, and the compression chamber 16 communicates with the ejection path 6g and the compression chamber 17 communicates with the ejection path 6i.

[0026] In the scroll compressor thus constituted, when the orbiting scroll 6 is moved eccentrically (in an orbit) by the rotational drive of the crank shaft 8, the fluid to be compressed is sucked in from the suction tube 9 and compressed in the compression chambers 16 and 17. Once it reaches a predetermined pressure (ejection pressure), it passes through the ejection paths 6g and 6i,

the ejection hole 6h, and the ejection hole 4c, and is ejected from the ejection path 2a into the ejection space 1a in the top of the sealed container 1, and is then passed through the ejection tube 10 and is ejected out of the sealed container 1.

[0027] A release structure of the first and second stationary scrolls 4 and 5 when the pressure in the compression chambers 16 and 17 becomes abnormally high or liquid compression occurs is described next.

[0028] The fitting structure of the first stationary scroll 4 with respect to the first frame 2 is constituted such that a seal ring 4d is fitted to the ring-shaped recess 2b formed in an inner face of the first frame 2 and to a ring-shaped protrusion 4e formed on an outer face of the first stationary scroll 4 so as to be slidable in the axis direction, forming a ring-shaped action chamber 18 between the bottom of the recess 2b and the tip of the protrusion 4e. On the other hand, the fitting structure of the second stationary scroll 5 with respect to the second frame 3 is constituted such that a seal ring 3b is fitted to the ring-shaped recess 5f formed in an inner face of the second frame 3 and to a ring-shaped protrusion 3c formed on an outer face of the second stationary scroll 5 so as to be slidable in the axis direction, forming a ring-shaped action chamber 19 between the bottom of the recess 5f and the tip of the protrusion 3c. The two action chambers 18 and 19 communicate with the compression chambers 16 and 17 by the communication holes 4f and 5g

perforated in the first stationary scroll 4 and the second stationary scroll 5. Here, the pressure in the action chambers 18 and 19 can be set arbitrarily according to the position of the opening of the communicating holes 4f and 5g with respect to the compression chamber 16 and 17, and is set so as to be an intermediate pressure or a suction pressure.

[0029] The axis direction side face of the outer circumferential portion of the mirror plate of the second scroll 5 and the contact (abutting) surface of the outer circumferential portion of the second frame 3 and the first frame 2 are machined and assembled such that the width direction dimensions are within the same surface within a certain machining tolerance. When the orbiting scroll 6 is assembled onto the second stationary scroll 5 in this state (with the mirror plate of the second stationary scroll 5 and the mirror plate of the orbiting scroll 6 abutting), they are set such that an appropriate gap from the point of view of performance and reliability is created at the tips of the lap 6a of the orbiting scroll 6 and the lap 5a of the second stationary scroll 5. In other words, an appropriate gap from the point of view of performance and reliability is set, and the lap length of the lap 6a of the orbiting scroll 6 is determined, based on the reference on the lap length of the lap 5a of the second stationary scroll 5. By the same token, the lap length of the first stationary scroll 4 and the orbiting scroll 6 are determined. Here, the fact that a side face of the outer circumferential portion of the

mirror plate of the first stationary scroll 4 is in contact with a side face of the outer circumferential portion of the mirror plate of the second stationary scroll 5 is the reference. The width-direction dimension is determined based on the side face of the outer circumferential portion of the mirror plate of the second stationary scroll 5 in this way.

[0030] Next, the gap between the tip of the lap 6a of the orbiting scroll 6 and the tip of the lap 5a of the second stationary scroll 5 when the compressor is operating is discussed. To make the description succinct, the relationship between the orbiting scroll 6 and the second stationary scroll 5 is discussed. First, the axis-direction force working upon the second stationary scroll 5 is a force pushing the second stationary scroll 5 upward (in a direction pushing the second stationary scroll 5 towards the orbiting scroll 6), being (1) a force (F1) in which ejection force is multiplied by the axis-direction projected surface area of the space 5h formed by the crank shaft 8 and the wall of the ring-shaped recess 5f at the center of the second stationary scroll 5, (2) a force (F2) in which pressure inside the action chamber 19 is multiplied by the axis-direction projection surface area of the action chamber 19, and (3) a force (F3) in which suction pressure is multiplied by the axis-direction projection surface area of a space 20 formed by the wall of the ring-shaped recess 5f and the second frame. On the other hand, a compression force (F4) of the compression chamber 17 acts as a force

pushing the second stationary scroll 5 downward (a direction pulling the second stationary scroll 5 away from the orbiting scroll 6). As a result, a locomotive force equal to the difference between the compression force F4 and the combined force of forces F1 through F3 acts on the second stationary scroll 5. Here the forces which are determined if the operating conditions of the compressor are determined are F1, F3, and F4, and the gap between the top of the lap 6a of the orbiting scroll 6 and the lap 5a of the second stationary scroll 5 is determined by F2. In other words, the force F2, or the axis-direction projection surface area of the action chamber 19 or the pressure in the action chamber 19 is determined such that an appropriate gap determined from the point of view of performance and reliability is set.

[0031] Operation is described next. When the scroll compressor thus constituted is operated, ordinarily the balance among the forces F1 through F4 is set such that $F1+F2+F3 \geq F4$, and the side face of the outer circumferential portion of the mirror plate of the first stationary scroll 4 and the second stationary scroll 5 slides against the side face of the outer circumferential portion of the mirror plate of the orbiting scroll 6 while maintaining an appropriate (set) gap value which is the gap between the tip of the lap 6a of the orbiting scroll 6 and the tip of the lap 5a of the second stationary scroll 5, and the lap 4a of the first stationary scroll 4. If in this state a phenomenon such as, for example, abnormal rising of liquid

compression or compression chamber pressure, the balance of the forces F1 through F4 becomes F1+F2+F3<F4, a force appears which attempts to separate the second stationary scroll 5 and the first stationary scroll 4 from the orbiting scroll 6. The first and second stationary scrolls 4 and 5 retreat in the axis direction, and the sliding contact of between the orbiting scroll 6 at the side face of the outer circumferential portion of the mirror plate of the first stationary scroll 4 and the side face of the outer circumferential portion of the second stationary scroll 5 disappears, and the pressure ceases to rise abnormally, thanks to a drop in pressure (high pressure) leaked to the low-pressure side by the gap at the lap tips expanding. Accordingly, the stationary scrolls 4 and 5 and the orbiting scroll 6 do not need to be made of a thick material which can withstand abnormal pressure, making it possible to constitute the compressor compactly and with light weight, and able to withstand the desired pressure.

[0032] Note that this example is constituted so as to release both the first stationary scroll 4 and the second stationary scroll 5, but this is not a limitation, and it is also possible to vary this, for example, and employ a constitution in which the first stationary scroll 4 and the first frame 2 are made as a single member, this is secured to another member as the first stationary scroll 4, and only the second stationary scroll 5 is released.

[0033] As described above, with this example, the outer shape of the mirror plate of the orbiting scroll 6 can be made smaller by employing a structure in which the end portion of the outer curve of the coil end portion of the lap 6a of the orbiting scroll 6 approximates or matches the circumferential edge of the mirror plate.

[0034] Further, the outer shape of the compressor can be made smaller by constituting the Oldham coupling 15 with a ring-shaped structure in which ring portions which are split in two from the center of the key width are joined, and the ring portions 15a and 15b of the Oldham coupling 15 are contained inside the recess 6e formed in the center in the width direction of the mirror plate of the orbiting scroll 6 and both slide.

[0035] Further, the compressor can be operated while always maintaining an appropriate gap between the lap tip of the orbiting scroll 6 and the lap tip of the stationary scrolls 4 and 5 by constituting the first stationary scroll 4 and the second stationary scroll 5 so as to be releasable in the width direction with respect to the orbiting scroll 6, and the effect of being able to avoid abnormal load on the sliding face between the side face of the outer circumferential portion of the mirror plate of the orbiting scroll 6 and the side face of the outer circumferential portion of the mirror plates of the stationary scrolls 4 and 5 by releasing the stationary scrolls 4 and 5 from the orbiting scroll 6 when a phenomenon occurs

such as, for example, abnormal increases in liquid compression or pressure in the compression chamber.

[0036] Further, a large centrifugal force is created by eccentric motion of the orbiting scroll 6 when the electric motor which drives the orbiting scroll 6 is caused to rotate rapidly (e.g., 6000-9000 rpm) through inverter control in order to control output over a wide area using a compact compressor. This centrifugal force is canceled by the lower balance weight 13, but moment is created in the crank shaft 8 with the second frame shaft bearing 3a acting as a fulcrum. This moment is canceled out by the upper balance weight 14 attached to the end of the upper supporting shaft portion 8c, making it possible to realize quiet operation since the vibration even at high operating speeds does not increase.

[0037] Next follows a description of another example of the present embodiment. FIG. 6 is a vertical cross-section lateral view showing a second example of the scroll compressor according to the present invention cut open and expanded at an angle of 90°. FIG. 7 is an oblique view of an Oldham coupling used in this example. Here, the same reference numerals are used for constituent parts common with the first example shown in FIG. 1 to FIG. 5, and detailed description thereof is omitted.

[0038] The feature of this example compared with the first example is that the orbiting scroll is split in two in the width direction. In other words, a first orbiting scroll 60 is provided

with respect to the first stationary scroll 4, and a second orbiting scroll 61 is provided with respect to the second stationary scroll 5. The ring portion 15a of the Oldham coupling 15 is slidably contained in the recess 6e formed in the center in the width direction of the first orbiting scroll 60 and the second orbiting scroll 61, acting to prevent rotation of the orbiting scrolls 60 and 61. As shown in FIG. 7, the Oldham coupling 15 is constituted from one ring portion 15a and four key portions 15c, 15d, 15e, and 15g, each engaging and sliding in the key grooves formed in the first orbiting scroll 60, the second orbiting scroll 61, the first stationary scroll 4, and the second stationary scroll 5.

[0039] The biggest advantage of making the orbiting scrolls two-geared is that the thrust loads in the width direction generated when compressing the fluid to be compressed are canceled out, and deformation of the orbiting scroll mirror plates by the compression load can be avoided. With a single orbiting scroll, the orbiting scroll mirror plate of one orbiting scroll must be made thicker to prevent deformation of the orbiting scroll mirror plate, but by constituting the orbiting scrolls as in this example, the upper and lower orbiting scrolls 60 and 61 restrict each other’s deformation, making it possible to make the mirror plates of the orbiting scrolls 60 and 61 as thin as possible.

[0040] The release structure and operation of the stationary scrolls 4 and 5 are the same as in the aforementioned example, so description thereof is omitted.

[0041] With this example, the orbiting scrolls 60 and 61 are split in two in the width direction, improving ease of assembly and making it possible to constitute the Oldham coupling 15 as a single unit and make it compact. Further, there is the effect of being able to make the thickness of the mirror plates of the orbiting scrolls 60 and 61 thinner.

[0042] Next follows a description of yet another example of the present embodiment. FIG. 8 is a vertical cross-section lateral view showing a third example of the scroll compressor according to the present invention cut open and expanded at an angle of 90°. The same reference numerals are used for constituent parts which are the same as in the first example and the second example, so description thereof is omitted.

[0043] The feature of this example is in interposing the elastic supporting bodies 22 and 23 with square cross-sections between the first orbiting scroll 60 and the second orbiting scroll 61 which are split in two, and forming an appropriate gap between the rear faces (faces opposite the laps) of the first orbiting scroll 60 and the second orbiting scroll 61, and linking these. The elastic supporting bodies 22 and 23 are formed from self-lubricating members having elasticity, and are disposed fitted into the ring-like grooves formed

in the first orbiting scroll 60 and the second orbiting scroll 61. Since there is no relative rotational movement in the first orbiting scroll 60 and the second orbiting scroll 61, there is not necessarily a need for the elastic supporting bodies 22 and 23 to be self-lubricating members.

[0044] With a single-gear-type scroll compressor, and not just with the two-gear type of this example, the setting of the gap at the lap tips is the most important factor in terms of performance and reliability. In other words, maximizing the efficiency of the compressor is affected by how small the gap between the lap tips can be set without detrimental effects on reliability (durability) during operation of the compressor. Accommodating this technical problem is the release structure of the stationary scrolls 4 and 5 described above, but this is realized in this example by constituting the orbiting scroll so as to be able to move in order to release from the stationary scrolls.

[0045] Since the elastic supporting bodies 22 and 23 are formed from self-lubricating members having elasticity, when a force is created which tries to separate the first and second orbiting scrolls 60 and 61 from the first and second stationary scrolls 4 and 5, a force acts to shrink the elastic supporting bodies 22 and 23 acts on the rear faces (the faces opposite the laps) of the first and second orbiting scrolls 60 and 61, the elastic supporting bodies 22 and 23 shrink, and the first and second orbiting scrolls 60 and 61 are

released from the first and second stationary scrolls 4 and 5 in the width direction. When the force acting to separate the first and second orbiting scrolls 60 and 61 from the first and second stationary scrolls 4 and 5 decreases and the elastic force of the elastic supporting bodies 22 and 23 increases, a restorative force pushing the first and second orbiting scrolls 60 and 61 towards the first and second stationary scrolls 4 and 5 is created. Thus, by disposing the elastic supporting bodies 22 and 23 on the rear faces of the first and second orbiting scrolls 60 and 61, it is possible to further stabilize the attitude of the first and second orbiting scrolls 60 and 61 during orbiting motion. Moreover, the release operation of the first and second stationary scrolls 4 and 5 is the same as above, so description thereof is omitted.

[0046] With this example, the attitude of the orbiting scrolls 60 and 61 can be further stabilized by disposing the elastic supporting bodies 22 and 23 between the rear faces of the first orbiting scroll 60 and the second orbiting scroll 61 having a structure in which the orbiting scroll is split in two in the width direction at the center of the mirror plate, and further it is possible to avoid abnormal loads on the sliding face between the side face of the outer circumferential portion of the mirror plates of the orbiting scrolls 60 and 61 and the side face of the outer circumferential portion of the mirror plate of the stationary scrolls

4 and 5 by releasing the orbiting scrolls 60 and 61 from the stationary scrolls 4 and 5.

[0047] Moreover, when a constitution is used for releasing the orbiting scrolls 60 and 61 from the stationary scrolls 4 and 5 by causing them to advance and retreat in the width direction, the same effect can be obtained as by having the stationary scrolls 4 and 5 fixed to the frames 2 and 3 and making them unable to advance or retreat.

[0048]

[Effect of the Invention] With the present invention, it is possible to make the outer size of the orbiting scrolls small by placing an Oldham coupling which stops the orbiting scrolls from rotating by engaging the orbiting scrolls and at the same time allows eccentric circular motion in a recessed groove portion formed in the outer circumferential surface of the flat plates of the orbiting scrolls.

[0049] Further, desired compression characteristics can be obtained as forming the end portions of the outer curves of the orbiting laps of the orbiting scrolls so as to approximate or match the outer circumference of the flat plates of the orbiting scrolls, thus making it possible to increase the number of coils of the orbiting lap with respect to the small-diameter orbiting scrolls.

[0050] Further, by allowing the stationary scrolls and the orbiting scrolls to advance and retreat (release) relatively in the

width direction, it is possible to operate the compressor while stabilizing the attitude of the orbiting scrolls when orbiting while maintaining an appropriate gap between the lap tip of the orbiting scrolls and the lap tip of the stationary scroll. Further, if a phenomenon such as abnormal increases in the liquid compression or compression chamber pressure occurs, an abnormal load can be avoided on the sliding face of the side faces of the outer circumferential portions of the mirror plates of the scrolls by the stationary scrolls and the orbiting scrolls releasing, which improves reliability.

[0051] Further, attaching to the drive shaft a balance weight to counteract the eccentric circular motion of the orbiting scroll and a balance weight to counteract the moment acting on the drive shaft makes is possible to cancel the centrifugal force and the moment generated by the eccentric circular motion of the orbiting scrolls, thus making it possible to suppress vibration during high-speed operation, and allowing quiet operation.

[Brief Descriptions of the Drawings]

[FIG. 1] is a vertical cross-section lateral view showing a first example of a scroll compressor according to the present invention.

[FIG. 2] is an oblique view of an Oldham coupling in the first example shown in FIG. 1.

[FIG. 3] is a horizontal cross-section plane view of an orbiting scroll in the first example shown in FIG. 1.

[FIG. 4] is a horizontal cross-section plane view of a second stationary scroll in the first example shown in FIG. 1.

[FIG. 5] is a horizontal cross-section plane view of a first stationary scroll in the first example shown in FIG. 1.

[FIG. 6] is a vertical cross-section lateral view showing a second example of a scroll compressor according to the present invention.

[FIG. 7] is an oblique view of an Oldham coupling in the second example shown in FIG. 2.

[FIG. 8] is a vertical cross-section lateral view showing a third example of a scroll compressor according to the present invention.

[Explanation of the Reference Numerals]

1: Sealed container

2: First frame

3: Second frame

3b Seal ring

4: First stationary scroll

4a: Stationary lap

4d: Seal ring

4f: Communicating hole

5: Second stationary scroll

5a: Stationary lap

5g: Communicating hole

6: Orbiting scroll

6a: Orbiting lap

6e: Groove

6f: Mirror plate

8: Crank shaft

13: Lower balance weight

14: Upper balance weight

15: Oldham coupling

16,17: Compression chamber

18,19: Action chamber

23,24: Elastic supporting body

Figure 1

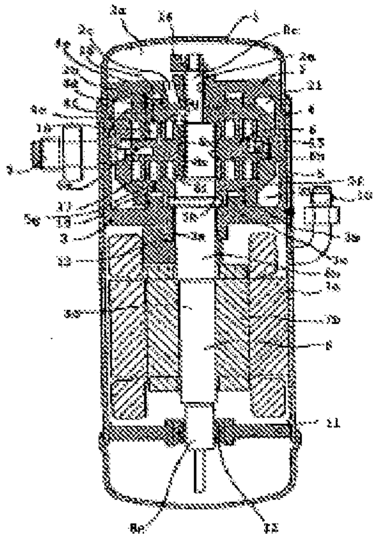

Figure 2

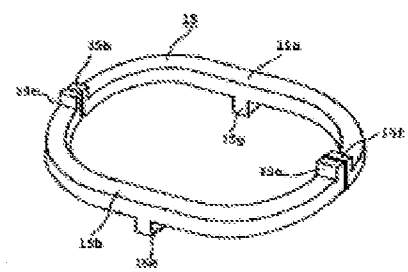

Figure 3

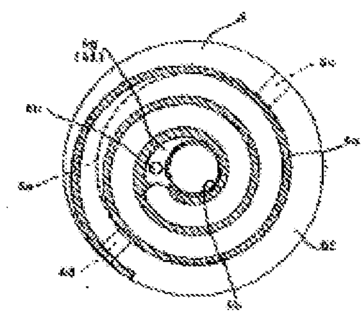

Figure 4

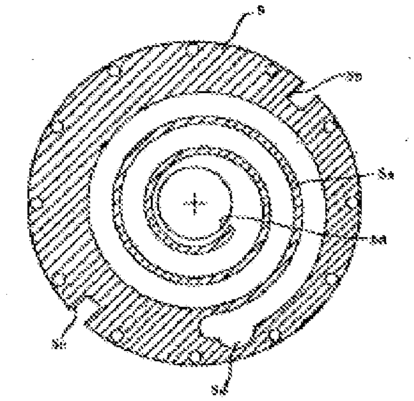

Figure 5

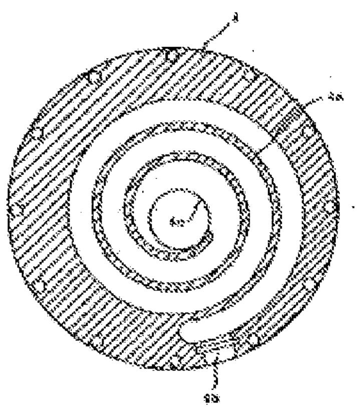

Figure 6

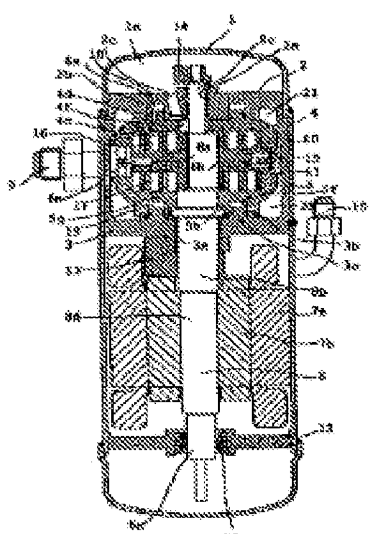

Figure 7

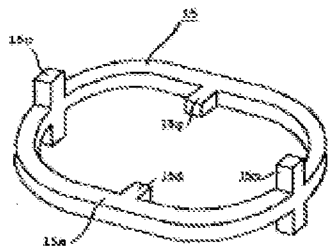

Figure 8